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Botanical novelties from the Sierra de Maigualida, southern Venezuela III: revision and two new species of the genus *Ilex* (*Aquifoliaceae*)

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Abstract. The Sierra de Maigualida is a poorly explored mountain range in the central Guayana Shield with high levels of endemism. In the present installment, this area is further delimited and mapped, toponymy is reviewed, and the genus *Ilex* L. is locally reviewed, with two species, namely *I. huberi* J.R.Grande sp. nov. and *I. maigualidensis* J.R.Grande sp. nov., described as new to science. *Ilex huberi* sp. nov. can be distinguished by its leaf blades strongly revolute, mucronate, and with obscure secondary venation, simple dichasia, and depressed-lunate sepals; *I. maigualidensis* sp. nov. by its dull leaves, flowers with undeveloped styles, and capitate-subcoronate stigmata. Stem buds and cataphylls are proposed as useful characters in species delimitation within the genus, while *I. magnifructa* Edwin is illustrated for the first time. A key is presented to differentiate all the species of *Ilex* of the Sierra de Maigualida.

Keywords. Guayana Shield, *Ilex*, new species, Sierra de Maigualida, Venezuela.

Resumen. La Sierra de Maigualida es un sistema montañoso del centro del escudo guayanés escasamente explorado, el cual presenta un alto grado de endemismo. En la presente entrega, esta área es nuevamente delimitada y mapeada, se corrige la toponimia y se revisan las especies del género *Ilex* L. que allí crecen, dos de las cuales, *I. huberi* J.R.Grande sp. nov. e *I. maigualidensis* J.R.Grande sp. nov., se describen como nuevas para la ciencia. *Ilex huberi* sp. nov. puede ser diferenciada por sus hojas fuertemente revolutas, mucronadas y con venación secundaria obscura, dicasios simples y sépalos depreso-lunados; *I. maigualidensis* sp. nov. por sus hojas opacas, flores con estilos reducidos y estigmas capitado-subcoronados. Las yemas vegetativas y los catafilos son propuestos como caracteres útiles en la delimitación de especies dentro del género e *I. magnifructa* Edwin se ilustra por primera vez. Se incluye una clave para diferenciar todas las especies maigualideñas de *Ilex*.

Palabras clave. Escudo Guayanés, especies nuevas, *Ilex*, Sierra de Maigualida, Venezuela.

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INTRODUCTION

According to recent systematic studies, the family *Aquifoliaceae* Bercht. & J.Presl is monogeneric (Cuénoud & al. 2000; Powell & al. 2000; Loizeau & Barriera 2009; Stevens 2012). Its only genus, *Ilex* L., includes c. 500 (Galle 1997) to c. 600 (Cuénoud & al. 2000) extant species which are distributed in South America (c. 300 spp.), South and East Asia plus New Caledonia (c. 250 spp.), the northern Australia (2 spp., cf. Manen & al. 2010), North and Central America plus the Caribbean islands (c. 60 spp.), Europe and the northern Africa (4 spp., including the type species, *I. aquifolium* L.), Macaronesia (2 spp.), Africa southwards from the Sahara (1 sp.), and the Pacific islands (2 spp.). The last phylogenetic surveys show the species of *Ilex* to be grouped in four main clades, fairly related with their geographic distribution and ecological features (Cuénoud & al. 2000; Loizeau & Barriera 2009). Seventy-six species and six varieties have been reported for the Guayana Shield (Berry & al. 2007), many of them endemic (cf. Steyermark & Berry 1995). Twenty-four species have been placed under the nearly endemic *I.* sect. *Guayanoilex* Edwin, which includes twenty three endemic species plus *I. divaricata* Mart. ex Reissek, which is also found in the Brazilian Amazon and the southwestern Colombia.

Biodiversity prospecting has been associated with geographical exploration. The Guayana Shield is not an exception, with the discovery of several mountains and massifs in the course of botanical expeditions (v.gr., Maguire & Deery de Phelps 1951; Maguire & Wurdack 1959). Geographic and cartographic information from this area, however, has been accumulated since the last decade of the XXth century in a rather steady way, but has not been comprehensively treated to the present. The following notes summarize the geography of the study area, with relevant updatings in topography and toponymy from the maps offered in Huber & Berry (1995), Huber (1995b),

Huber & al. (1997: 443 fig. 1), and the 'part I' of the series (Nozawa & al. 2010: 197 fig. 1). Additionally, two new species of the genus *Ilex*, *I. huberi* J.R.Grande sp. nov. and *I. maigualidensis* J.R.Grande sp. nov. are described.

Considering the still very preliminary exploration of Sierra de Maigualida, a surprisingly high number of endemic taxa have been described from there. As it was pointed out in Lourteig (1996), in fact, this mountain range is very promising for the study of plant evolution, since it includes unique or at least highly characteristic taxa inhabiting special and isolated ancient environments. One of the species described in the present contribution—*I. maigualidensis* sp. nov.—, for example, is the second member of the genus with conpicuous pubescence within the Guayana Shield, while the other—*I. huberi* sp. nov.—is the second species worldwide with a prostrate habit.

With the two species here established, the number of angiosperms endemic to Sierra de Maigualida reaches thirty-seven, including one genus, thirty-four species, one subespecies, and one variety. Additional species are currently studied and will be published as new in future installments.

MATERIAL AND METHODS

Cartography and toponymy were reviewed by means of the available pioneer maps, summarized in Salazar-Quijada (1983), and the literature cited in the text.

The dry collected material of the genus *Ilex* from Sierra de Maigualida and housed at the herbaria MYF and VEN was reviewed and identified. Measurements were performed directly on dried specimens, using a stereoscopic microscope to study the pubescence. Relevant literature was also reviewed, and the species concepts confirmed with the examination of the availabe type specimens at Jstor Plant Sciences (https://plants.jstor.org/) and reviewed herbaria. The following descriptions are based on the aforementioned sources, as well as from the corresponding field notes of accompanying labels.

RESULTS AND DISCUSSION

Geography

Recent advances in cartography have made available high resolution imagery for extensive areas of the Earth's surface, freely available on the internet. The map of the fig. 1, prepared from a pancromatic image from the program Google Earth (https://www.google.com/intl/es/earth/,

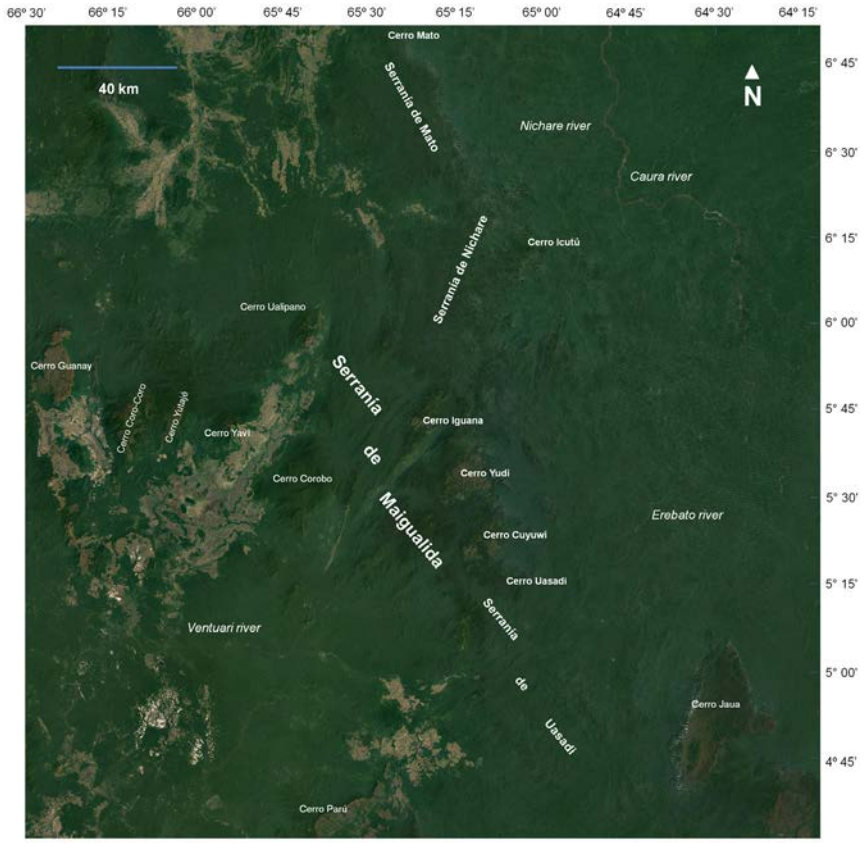

Fig. 1. Map of Sierra de Maigualida and surroundings, including updated toponymy.

accessed 31 Jul. 2019), shows the traditional subdivision of Cordillera de Maigualida, an oronym apparently coined by Marrero (1964). It is a crystalline mountain chain made up of a number of more or less isolated mountains, mountain ranges and massifs, uplifted after the Amazonian orogenesis (1,7–2 Gy) in the Cuchivero geological province, that shows extensive rock outcrops of granites of the 'Santa Rosalía group' (Rincón & Estanga 1996), and embraces, from north to south, the Serranía de Mato (NW-SE orientation and elevations never surpassing 1500 m a.s.l.), the Serrranía de Nichare (NW-SE orientation and elevations rarely surpassing 1500 m a.s.l., never reaching 2000 m a.s.l.), the Serranía de Maigualida (N-S general orientation, and main faults oriented NE-SW), and the Serranía de Uasadi (mainly hilly, not surpassing 1000 m a.s.l., except for its northernmost part, where it scarcely reaches 1500 m a.s.l., and with the same general orientation of the Serranía de Nichare). This huge mountain complex, nearly 250 km long, and a roughly N-S extension, between 6°50′ and 4°40′ N, and 64°50′ and 65°50′ W, is the longest and one of the most extensive mountain systems of the Guayana Shield, the source of the rivers Caura, Erebato, Manapiare and Cuchivero rivers, as well as of several of the main tributaries of the Ventuari river (Huber 1995a: 21 figs. 1–16). Its highest elevation, Cerro Yudi, is located towards the north of the Sierra de Maigualida, and reaches c. 2400 m a.s.l., the surrounding highlands lying mostly between 1600 and 2200 m a.s.l. (Nozawa & al. 2010). The name Serranía de Maigualida, by the other hand, has been used on maps only recently, probably just from the 2000s. It includes the Cerro Ualipano, floristically related to the Sierra de Maigualida, and the Cerro Corobo ("Cerro Coroba" in some recent references, as Huber & Berry 1995), besides of several actually unnamed mountains and massifs.

Sierra de Maigualida, the studied area, includes extensive mountains and dissected plateaus, with several types of ombrophilous basimontane and montane forests on its slopes, and a mosaic of saxicolous vegetation, shrublands, highland low forests and tepui broad-leaved and grass-dominated meadows over ultisols, entisols, rock exposures and organic soils, only very preliminary mapped and described (cf. Huber 1995c; Rosales & Huber 1996; Huber & Rosales 1997; Riina & Huber 2003). As it is here circumscribed, it includes only the highest and easternmost portion of Serranía de Maigualida, made up of three main blocks, which are, from north to south, the Cerro Iguana ("sector noroccidental" in previous literature and herbarium labels), the Cerro Yudi ("sector nororiental"), and the Cerro Cuyuwí ("Serranía de Uasadi").

Description of two new species

Five species of the genus *Ilex* have been collected in the Sierra de Maigualida (fig. 1), above 1500 m a.s.l.: *I. huberi* sp. nov. (fig. 2), closely related to a species of *I.* sect. *Vacciniifoliae* Loes. from the Espinhaço range (eastern Brazil), *I. maigualidensis* sp. nov. (fig. 3), a species of indefinite affinities, and three species of *I.* sect. *Guayanoilex*, namely *I. magnifructa* Edwin (fig. 4), *I. marginata* Edwin, and *I. retusa* Mart. ex Reissek, the two former ones included within *I.* ser. *Lateraliae* Edwin.

The following descriptions consider the types of inflorescence and stigma proposed by Edwin (1965) for the Guayanan species. Despite the fact that neither stipules, nor prophylls or prophyllate bracts have been considered of taxonomic importance (Edwin 1965), cataphylls and apical buds have some diagnostic value, at least for the species of the Sierra de Maigualida. They are described in the following paragraphs and included in the key.

Ilex huberi J.R.Grande sp. nov. Type: Venezuela, Amazonas State, "dpto. Atures [mun. Manapiare]: Sierra de Maigualida, sector nor-oriental, altiplanicie disectada de granito en las cabeceras nor-orientales del río Iguana, afluente del río Ventuari", 5°40′ N, 65°8′ W, ± 2150 m a.s.l., 24 Nov. 1989, *O. Huber 13079* leg. (holo-: MYF 11255!; iso-: MO-1170816, MYF 11367!). Fig. 2.

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Species haec, inter species generis habitu prostato et foliis coriaceis petiolo pilis minutis atque sparsis, laminis lustrosis conspicue revolutis apice acuminatis acumine indurato, valde distincta.

Decumbent and prostrate shrubs with stems elongate; ramullets striate, grayish, generally subopposite or subverticillate, 1–3 each node, the apical portions pubescent, turning glabrous when mature; cataphylls c. 1 × 0.4 mm, narrowly oblong, with involute margings, acute and extrosely folded at the apex. Leaves subimbricate, grouped towards apex of ramullets, shortly petiolate; stipules similar to the cataphylls, caducous; petioles 1.5–3 mm long, pubescent when young, turning puberulous when mature; leaf blades 1.4–1,75 × 0.4–0.55 cm, coriaceous, shiny, ochraceous to dark brown in sicco, base cuneate, margins strongly revolute, appearing oblong to long-ovate or long-obovate, apex scarecely revolute, discretely mucronate, the mucro elongate, conspicuous and indurate; epiphyll blackish when young; midvein blackish on both sides when young, conspicuously impressed adaxially, prominent to carinate abaxially; secondary venation as well as that of following orders obscure. Male inflorescences 1–3-flowered, 2–3.5 mm long, axillary, the 'type 4' of Edwin (1965), dark brown, with inconspicuous, pubescent bracts reduced to scales; peduncles c. 1.5 mm long; pedicels 0.75–1.5 cm long. Calyx dark brown; sepals c. 0.75 × 0.85 mm, depressed-lunate. Corolla grayish-white;

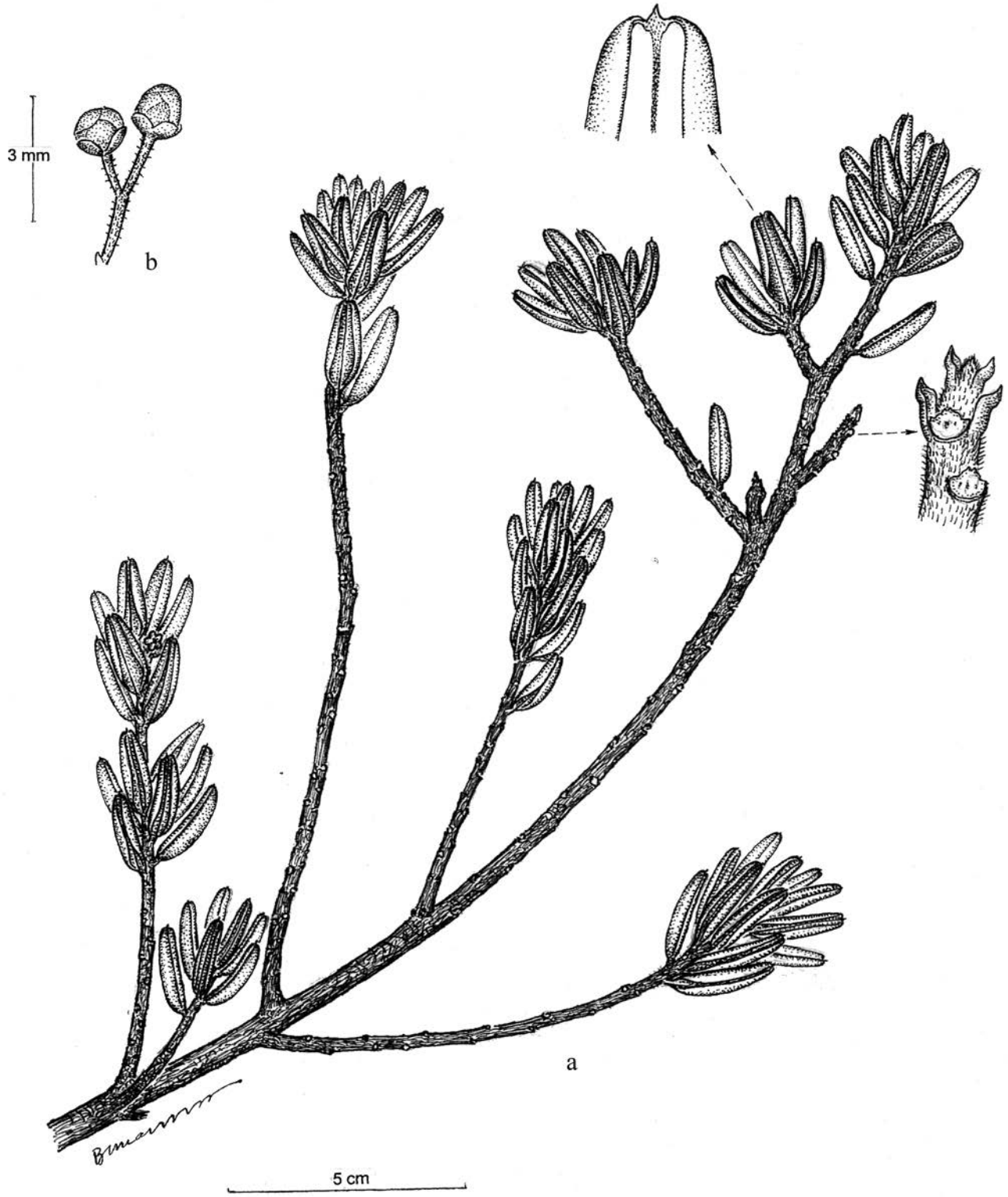

Fig. 2. *Ilex huberi* J.R.Grande sp. nov., *O. Huber 13079* leg. (MYF 11255): **a,** habit, including details from leaf blade apex and apical portion of a ramullet, showing a vegetative bud; **b,** male inflorescence.

petals c. 2 × 1.8 mm, widely ovate to subrotund. Stamens included; anthers c. 0.5 × 0.3 mm, oblong, yellowish.

Etymology.—This species in named to honour my dear friend and teacher Dr. Otto Huber, whose pioneer studies in the Guayana Shield have led to the discovery of many new plants. Curiously enough, type of *I. huberi* sp. nov. was collected on his birthday.

Distribution and habitat.—*Ilex huberi* sp. nov. is known by a single collection, consisting of three duplicates from a single male plant collected near the summit of Cerro Yudi. It was found creeping on rocks, in an exposed area under the influence of heavy winds, where it seems to be a frequent species. It may be postulated that strong winds are the cause of the prostrate habit, but populations of *I. maigualidensis* sp. nov., which grows very nearby, are always upright. Based on label information, it flowers in November.

Notes.—The hairs are, in this species, scarce and restricted to the young stems, inflorescences, and petioles; they are always minute, subulate, and septate. All the known terminal branches or ramullets are sterile, except one from the holotype. Despite being an endemic of the Guayana Shield, *I. huberi* sp. nov. seems to be more closely related to *I. prostrata* Groppo, from the '*campos rupestres*' of the crystalline mountain range of Serra do Cipó, a southern portion of the Espinhaço range in the Minas Gerais state of Brazil. That species, assigned in its protologue to *I.* sect. *Vacciniifoliae* (Groppo & Pirani 2002), has in common with *I. huberi* sp. nov. the prostrate habit, reduced leaves, and single dichasia (sometimes further branched in its lateral flowers, corresponding to the 'type 4' of the inflorescence type system of Edwin 1965). The new species can be differentiated, however, by the leaf baldes strongly revolute, mucronate and with an obscure secondary venation, the presence of strictly simple dichasia (vs. lateral axes further ramified), and depressed-lunate sepals (vs. widely deltoid). The habitats of these two species are similar, since *I. prostrata* grows also on granitic plateaus, over sandy-rocky soils or among rocks at c. 1100 m a.s.l. (Groppo & Pirani 2002). Since no species of *I.* sect. *Guayanoilex* and *I.* sect. *Vacciniifoliae* from the Espinhaço range have been included so far in a phylogenetic analysis (Groppo 2007; Manen & al. 2010), it is difficult to ascertain whether they are closely related, as is suggested by their geographic distribution and several morphological traits of the leaves and inflorescences. Phylogentic analyses, as well as deeper studies of relevant characters, should be conducted in order to know the true relationships of these two groups of species from ecologically similar areas.

Ilex maigualidensis J.R.Grande sp. nov. Type: Venezuela, Amazonas State, Atures [mun. Manapiare], Sierra Maigualida, NW sector, small valley along an upper tributary of Caño Iguana, 5°30′ N, 65°15′ W, 2000 m a.s.l., 28 Feb.–3 Mar. 1991, *P.E. Berry, O. Huber* and *J. Rosales C. 4892* leg. (holo-: VEN 329798!; iso-: MO-1173805; MYF 11238!). Fig. 3.

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Frutices plus minusve retorquati, ramullis foliis inflorescentiis floribus fructibusque tomentosis Ilice maguirei adhuc confusa, sed stylo ac rostro fructus nullis differt.

Shrubs 1–3 m tall, more or less gnarled; diameter of branches that subtend the subterminal ramifications to 0.56 cm; young portions of ramullets angulate, tomentose, turning terete when mature, generally blackish, the apical buds perulate and tomentose; subterminal branches cinereous-creamy, slightly suberified, scarcely cicatricose; bark conpicuously striate-reticulate, its surface rugose, not detachable, with rhomboid marks. Leaves alternate, shortly petiolate; stipules 0.6–0.8 × 0.6–0.7 mm, reduced to scales, acute, thickened towards base, more or less claw-shaped; petioles 1.5–2.5 mm long, short, tomentose; leaf blades (0.6)1.2–5.6 × (0.55)1–3.6 cm, elliptic, slightly ovate, slightly obovate or subrotund, adaxially as well as abaxially tomentose, the base symmetric, obtuse to rounded, the margins revolute, discretely serrate towards apex, apex more or less asymmetric, mucronate, rounded to obtuse, rarely emarginate. Female inflorescences 2–3-flowered, 0.4–1.5 cm long (not including the flowers and fruits) tomentose, solitary or cymose; peduncles 1–5 mm long, of similar thickness as petiole subtending it; pedicels 0.45–1.2 cm long, subtended by a triangular scale-like bract, 0.3–0.7 mm long, slightly longer than wide, glabrous or puberulent towards base and margins. Female flowers 2.2–2.5 mm long; sepals 1–1.25 × c. 1.5 mm, hirsutule to tomentose, lunate to widely triangular, the apex rotund to obtuse, margins entire, apex apiculate, the apicule indurate; petals and staminodes unknown; pistil 2–2.5 × 2.1–2.25 mm, obturbinate or more or less oblate, ovary pubescent to tomentose, style not developed, stigma conspicuous, glabrous, capitate-subcoronate, more or less 4-lobulate, sometimes also capitate and coronate in different ovaries from the same plant (cf. *Huber* and *Izquierdo 12804* leg.). Fruits pubescent to tomentose, obturbinate to ovoid when inmature, turning globose when mature, 8.5 mm long and diameter 7 mm *in sicco* to 1 cm *in vivo*, green to grayish green, turning dark purple when mature, crowned by a 1.2–1.8 mm long concrescent stigma, obturbinate; pedicels apparently not enlarging but clearly thickening, sepals persistent but, apparently, not concrescent.

Etymology.—*Ilex maigualidensis* sp nov. is named after its type locality (Sierra de Maigualida).

Distribution and habitat.—*Ilex maigualidensis* sp nov. inhabits forest borders (where it is scarce and 2–3 m tall *fide P.E. Berry* & al. *4892* leg. and *O. Huber 12804* leg.), and open places near rocks (where it is very scarce, c. 2 m tall, with rounded leaves and conspicuously globose fruits, *fide O. Huber 13073* leg.) or among rocks (where it is scarce, gnarled and very short, c. 1 m tall *fide O. Huber 13114* leg.). Based on the few available specimens, this species flowers in November, and bears fruits from November to March. Only female plants are known.

Notes.—In this species the pubescence is constitued, invariably, by a more or less fine and sparse tomentum, slightly rough to the touch, made up of more or less acicular setiform hairs, 0.2–0.7 mm long, which are septate, more or less recurved, and somewhat brittle. This is especially true for stems, where pubescence appears broken in mature portions, leaving a rough surface. The bark is partially covered by black piliform fungi, foliose bryophytes, crustose lichens or diminute plants of the family *Bromeliaceae* Juss., as it is common in the Pantepui area (Steyermark 1988; Grande & al. 2012). The affinities of *I. maigualidensis* sp nov. are unclear, but it shares with *I. maguirei* Wurdack, *I. chimantaensis* T.R.Dudley (as *I. sulcata* Edwin in Steyermark & Berry 1995), and *I. tepuiana* Steyerm. several foliar and reproductive characters. They include petiole length (relatively short), leaf shape (more or less elliptic), and inflorescence structure (single dichasia). *Ilex chimantaensis* and *I. tepuiana*, however, lack the characteristic indumentum of *I. maguirei*, the only additional species in Venezuelan Guayana with conspicuously

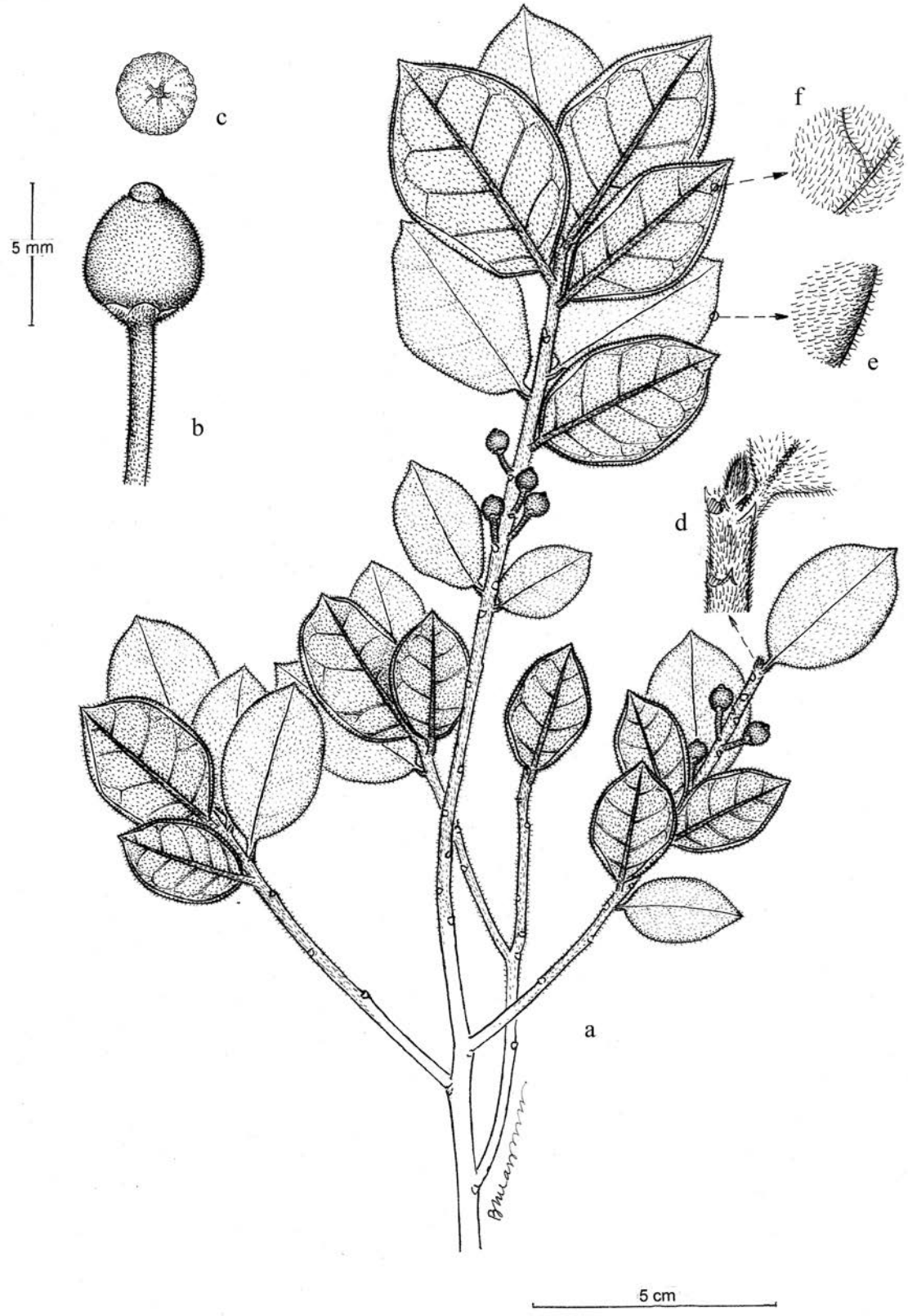

Fig. 3. *Ilex maigualidensis* J.R.Grande sp. nov., *P.E. Berry* & al. *4892* leg. (VEN 329798): **a,** habit; **b,** fruit, lateral view; **c,** fruiting stigma; **d,** apical portion of a ramullet, showing the perulate bud, a leaf, and stipules; e, pubescence from adaxial side of a leaf blade; **f,** pubescence from abaxial side of a leaf blade.

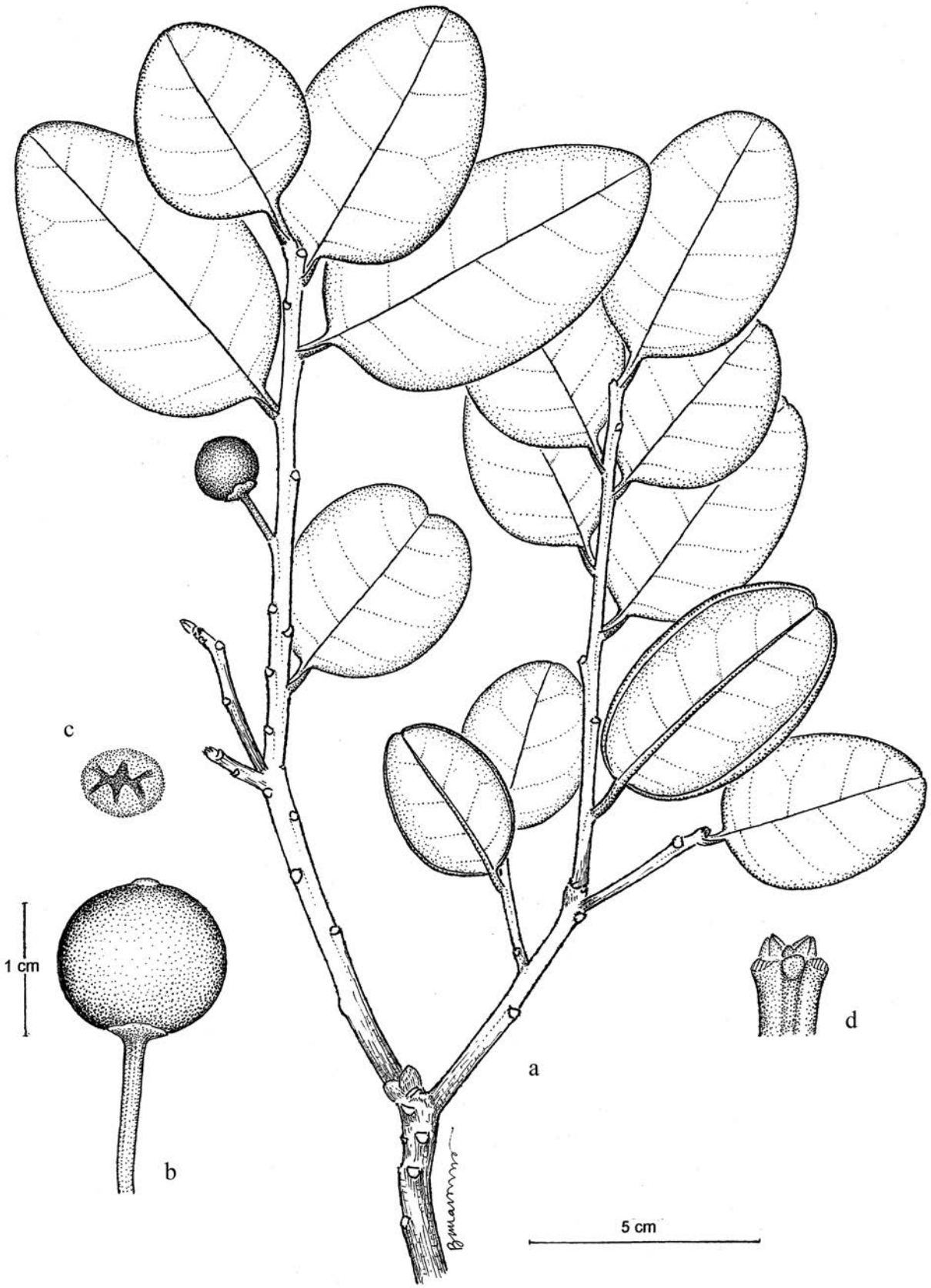

Fig. 4. *Ilex magnifructa* Edwin, *O. Huber 13061* leg. (VEN): **a,** habit; **b,** fruit, lateral view; **c,** stigma; **d,** apical bud.

tomentose stems, leaves, inflorescences, sepals, ovaries, and fruits. The type (*P.E. Berry* & al. *4892* leg.) and one of the paratypes (*O. Huber 13073* leg.) of *I. maigualidensis* sp nov. were erroneoulsy identified as *I. maguirei* (an endemic species from the Sierra de la Neblina) in the family treatment for the *Flora of the Venezuelan Guayana* (Steyermark & Berry 1995). This last species can be readily distinguished by the shiny (vs. dull) epiphyll, pistillate flowers with elongate styles and punctate stigmata (vs. style undeveloped and capitate-subcoronate stigmata), and inflorescence type (solitary flowers, with well-developed peduncles vs. single dichasia; inflorescence 'type 2' and 'type 4', respectively, according to Edwin 1965). While *I. maguirei* lives in shrublands over sandstone, *I. maigualidensis* sp nov. thrives in the border of the "elfin forests" and shrublands near or among granites, in the Sierra de Maigualida.

Additional specimens examined (paratypes).—VENEZUELA. **Amazonas State**: "Dpto. Atures [mun. Manapiare]: Sierra de Maigulida, sector nor-oriental, altiplanicie disectada de granito en las cabeceras nor-orientales del río Iguana, afluente del río Ventuari", 5°40′ N, 65°8′ W, c. 2150 m s.n.m., 23–25 Nov. 1989, *O. Huber 13073* leg. (MO-1173806, MYF 11035!, VEN 403646!); "Dpto. Atures [mun. Manapiare]: Sierra de Maigualida, sector noroccidental, en pequeño valle afluente izquierdo del caño Iguana medio", 5°33′ N, 65°15′ W, 2080 m a.s.l., 28 Feb.–3 Mar. 1991, *O. Huber 13114* leg. (MO-1173807, MYF 11364! × 2). **Bolívar State**: "Dtto. Cedeño [mun. Cedeño]: Sierra de Maigualida, sector nor-oriental, Altiplanicie tepuyana disectada sobre granito en las cabeceras del río Chajura [río Yudi], afluente derecho del río Erebato, ca. 100 km (en línea recta) al SW del campamento Entreríos", 5°33′ N, 65°13′ W, c. 2000 m s.n.m., 15–19 Nov. 1988, *O. Huber 12804* leg. (VEN 403644!).

Key to the species of Ilex of the Sierra de Maigualida

1. Upright shrubs; young stems, leaves, inflorescences, sepals, ovaries, and fruits tomentose; stigma capitate-subcoronate ..... ***I. maigualidensis*** J.R.Grande sp. nov.
– Upright or prostrate shrubs; plants glabrous or, if pubescent, never tomentose; stigma different 2
2. Prostrate shrubs; cataphylls c. 1 × 0.4 mm, with involute margins and extrorsersely folded apices; leaf blades conspicuously revolute and mucronate .... ***I. huberi*** J.R.Grande sp. nov.
– Upright shrubs; leaf blades flat to only slightly revolute, retuse 3
3. Leaf blades small, usually < 2.5 cm long, < 2 cm wide; stigma capitate; fruit pubescent ....… ***I. retusa*** Klotzsch ex Reissek
– Leaf blades larger, usually > 3 cm long, >2 cm wide; stigma capitate or coronate; fruit glabrous ……..... 4
4. Apical buds not perulate, reduced and conical-shaped; leaf blades ovoid, elliptic or suborbicular, concolorous, blackish in sicco; stigma capitate; fruit globose, smooth …..... ***I. magnifructa*** Edwin
– Apical buds perulate; leaf blades elliptic to obovate, ochraceous in sicco, discolorous, shiny; stigma coronate; fruit ovoid, slightly lobed ..... ***I. marginata*** Edwin

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